The following is a synoptical table of the genera of the family *Proteidæ*:—

Feet four or only two anterior ones. Eyes small, and without lids. Vertebræ biconcave.

Body
- much elongated, cylindrical; feet very small. Feet
  - two; branchiæ persistent..... *Siren.*
  - four; no persistent branchiæ; two nuchal fissures ..... *Amphiuma.*
  - four; branchiæ persistent ... *Proteus.*
- moderately elongated, more or less depressed. Feet four. *Branchiæ* .....
  - persistent throughout life; four toes on all the feet ..... *Menobranchus.*
  - persistent throughout life, in the form of long tufts; four toes on fore feet, five on hind feet ..... *Sirenodon.*
  - in early stages only; four toes on fore feet, five on hind feet..... *Cryptobranchus.*

XLVII.—*On some new Species of Fossil* Volutes *from the Tertiary Beds near Melbourne.* By Frederick M'Coy, Professor of Natural Science in the Melbourne University, Government Palæontologist to the Geological Survey, &c.

Figures of the following species, collected by the Geological Survey under Mr. Selwyn, will shortly appear in the Decades I am preparing on the recent and fossil zoology of Victoria. As, for some years, I have prepared descriptions of nearly all the known fossils of the colony, I have been pressed to send descriptions of the more remarkable forms to the 'Annals' for preliminary publication.

Voluta macroptera (M'Coy).

Shell fusiform until nearly adult, when the outer lip becomes dilated into a very large, thin-edged, triangular, flattened wing, the outer margin of which is slightly convex, the posterior margin concave, running up halfway to the suture of the penultimate whorl in a slight channel; the approximately rectangular junction of the outer and posterior margins broadly rounded. Apical angle about 55° in middle-aged specimens, and 35° in young ones 1½ inch long. Spire with a concave outline of four rapidly enlarging whorls and a mammillary cap-shaped pullus of one and a half turn, the basal halfturn of the pullus less than half the width of the next succeeding turn of the spire, the remain-

ing turn nipple-shaped, with a small eccentric projecting apex; the length of the pullus equalling once and a half the width of the next following turn of the spire. Each turn of the spire embracing the next preceding one at the suture, near which they are concave, then forming a convex shoulder and nearly parallel with the axis of the shell below; body-whorl fusiformly narrowed in front, and marked with a broad siphonal notch, without anterior crest or ridge. Inner lip excessively thin, moderately spreading; plaits of the columella four, widely separated, very prominent, narrow, one smaller. Aperture moderately wide, oblong, narrowed above and below, becoming effuse with age.

Pullus smooth; the next two turns of the spire with excessively fine spiral striæ, only visible with the lens (about ten or eleven in the space of 1 line); rest of the spire and body-whorl smooth or marked with fine lines of growth. Length of pullus 4 lines, width of ditto 3 lines; length of adult (including the pullus, which is 3 lines) 6 inches; proportional length of body-whorl $\frac{45}{100}$; length of wing $\frac{92}{100}$; width of body and wing $\frac{70}{100}$; width of body on inside of base of aperture $\frac{38}{100}$.

There is no living or fossil species at all like the present in the large, thin, angular, wing-shaped outer lip and fusiform body. Young specimens an inch and a half long are irregularly fusiform, of two whorls in addition to the pullus of nearly two.

The layer of shell bearing the microscopic spiral striæ seems very liable to fall off, leaving the whorls only marked by the lines of growth.

Not uncommon in the passage-beds of the tertiary sands, Ad. 22, at Bird Rock, near Geelong.

Voluta Hannafordi (M'Coy).

Fasciolaria Hannafordi, olim, MS.

Broad, fusiform; pullus at apex of spire, very large, smooth, spheroidal, of little more than one turn and a quarter; spire conical, apical angle 70°, of four whorls (besides the pullus), each obtusely angulated in the middle and bearing on the angle from twelve to seventeen large nodose tubercles, obtuse and conoidal on the body-whorl, on which the smaller number is found, more elongate on those of the spire, on the upper of which the greater number occur; the oblique space between the tubercles and the suture marked with narrow, slightly undulating, thread-like, spiral ridges, irregularly alternating in thickness; below the tubercles the body-whorl is smooth or marked with obtuse lines of growth as far as the anterior extremity, which is marked by thick obtuse spiral striæ crossing the lines of growth; but the young whorls or vertical portions of the smaller turns of the spire are marked with spiral striæ slightly larger and less

distinct than those of the posterior portion; and, finally, in very large old specimens, the spiral striæ on the space above the tubercles are reduced to a few near the suture. Outer lip in adults greatly dilated into an oblong wing, with a broadly rounded auriculate posterior margin rising up for attachment nearly to the suture of the penultimate whorl; outer margin nearly straight, thin, and slightly inflected, ending at the narrowed end with three large, equal, very prominent, compressed, widely separated, oblique plaits, besides which, in some examples, are one or two closer and smaller ones (usually absent); aperture moderately large, oblong.

Length of small perfect specimen 6 inches, proportionate length of body-whorl $\frac{72}{100}$, of penultimate whorl $\frac{13}{100}$, antepenultimate whorl $\frac{9}{100}$, preceding whorl $\frac{4}{100}$; length of pullus $\frac{3}{100}$, diameter of pullus $\frac{10}{100}$; diameter of succeeding whorl at suture $\frac{8}{100}$; length of wing $\frac{90}{100}$; greatest width of body-whorl and wing $\frac{65}{100}$, of penultimate whorl $\frac{32}{100}$; ordinary length of pullus 6 lines, diameter 7 lines.

So disproportionately large and smooth does the pullus or young nucleus on the top of the spire appear, that it looks like a comparatively large *Natica* or *Helix* artificially stuck on the comparatively slender, regularly nodulated, and striated spire, its disproportion far exceeding the greatest living instance of such an incongruity, the recent *Voluta mamilla*. The first very large specimen seen was presented by Mr. Hannaford, of Warnambool, an enthusiastic naturalist, after whom I have great pleasure in naming the species. This specimen, having the apex absent and the outer lip and the anterior end of the columella broken off, as well as possessing two unusual small plaits behind the others, looked so much more like a *Fasciolaria* than a *Voluta*, that in my manuscript I used the former generic name, until I saw other specimens showing the true characters of the notched anterior end, mammillary spire, &c.

There is no known recent or fossil species at all approaching it in general characters.

Rare in Tertiary clays of Muddy Creek, near junction of Grange Burn, five miles from Hamilton.

One very imperfect specimen, presented by Mr. Hannaford, from the clays of Port Fairy, Warnambool, where it occurs with several other species of the Mount Eliza beds. Rather rare in the clays near the foot of Mount Eliza, in Hobson's Bay, whence the perfect specimen was obtained, as well as a few fragments of the spire with the large nucleus attached. Rare in clays of the Orphan Asylum Reserve, Fyan's Ford, Ad. 28; rare in clays near Mount Martha.

Voluta antiscalaris (M'Coy).

Ovate, moderately ventricose, rather abruptly attenuated towards the front; spire moderately acute, apical angle 65° to 70°, of four to five whorls, and a rounded, swollen, smooth, oblique nucleus at the tip, of one turn and a half; body-whorl with about sixteen to twenty-four angular, slightly sigmoid longitudinal ribs extending rather less than halfway to the front, narrow and sharp in the young, wider and more obtusely angular in adults, becoming gradually obsolete in front, each ending in a sharp conical tubercle crowning the obtusely angulated shoulder; a second row of smaller, pointed, conical tubercles surmounts the larger on each whorl; the space between the two rows is deeply concave and rather wider than the interval between the corresponding larger tubercles; the space between the upper row and the suture is flattened, nearly horizontal, and about half as wide as the space between the two rows, both spaces marked only by the coarse lines of growth; whorls, anterior to the tubercles, crossed by deep, narrow, spiral sulci having flat spaces between them about equal to half the distance of the longitudinal ribs from each other; usually about three of these spiral striæ visible on each of the whorls of the spire, crossing the longitudinal ridges. Pillar-folds slender, widely separated, oblique, three or four, the third (or fourth, where it exists) posterior, abruptly smaller than the two anterior plaits; outer lip thin, smooth. Length of large specimens 2 inches; length of body-whorl $\frac{7}{10}\frac{3}{0}$, penultimate whorl $\frac{1}{10}\frac{5}{0}$; greatest width $\frac{4}{10}\frac{5}{0}$ to $\frac{5}{10}\frac{0}{0}$. A specimen 8 lines long gives all the same proportional measurements.

A careful comparison of specimens of the true *V. scalaris* (Sow.), from the Middle Eocene beds of the Isle of Wight and Barton, will show (what none of the existing figures or descriptions would) that our species, which I have named *V. antiscalaris*, is not identical, but a most remarkable instance of a representative form, distinguished with apparent doubtfulness by a slightly longer spire, less ventricose body, and the ribs less twisted at their anterior end, but with perfect certainty by the spire, which in the European species is sharply pointed (in accordance with the genus *Volutilites*, Swa.) and of eight or nine gradually and regularly tapering whorls, the apical two or three smooth; while in the Victorian species it terminates in an obtusely rounded, smooth, swollen nucleus or "pullus" of one turn and a half, below which are only five sculptured whorls in adult individuals. In accordance with the slightly more slender form, the pillar is less curved than in the English species, and the plaits slightly thinner and more oblique; the number of ribs in a whorl is greater (being about fourteen or fifteen in the English species);

but in all other characters the coincidence or representation of characters is so complete that, if the tip of the spire were in each case absent, the nicest eye could scarcely separate them; yet the distinguishing character is one of such importance, and so invariable, that there can be no doubt of its marking a perfectly distinct species.

This species is also closely allied to the *V. nodosa* (Sow.) of the Hampshire Eocene Tertiary, Barton Clay, and Bracklesham beds, but may be distinguished by the upper row of tubercles of the spiral whorls being distinctly separated from the suture by a space equalling about half the width of the space between the upper and lower rows of tubercles on each whorl, as in *V. scalaris*: one or two very old thick specimens show a spreading inner lip, and a very faint indication in some lights of a crenulation on the edge of the outer lip; and the plaits are thickened, and in one case an intermediate fifth plait appears.

Common in the Tertiary clays of (Ad. 14) parish Moolap; a variety not uncommon in Tertiary clays of Orphan Asylum Reserve, Fyan's Ford, Ad. 28, not uncommon in blue clays and limestone near Mount Martha. Var. *α. levior* has the apical angle 65° to 70°, often a fourth small columellar fold, and the spiral transverse sulci become nearly or quite obsolete near the spinous shoulder, and sometimes over more than half of the body-whorl as well as on the whorls of the spire; it is also a little stronger, but is certainly only a variety. In clays and limestone, Mount Martha.

Voluta anticingulata (M'Coy).

Ovate; spire moderately acute (apical angle varying from 55° to 65°, usually 60°), of five slightly convex, sculptured, gradually increasing whorls, and a smooth, rounded, small, swollen nucleus of one turn and a half; sutures twisted or subcanaliculated by a narrow flattened or hollow space separating the sutural line of conoidal tubercles, which are on the other side separated from the obtuse tubercular ends of the nearly straight longitudinal ribs by a deep spiral constriction or channel seeming to cut the ribs to the depth of the spaces between them; body-whorl obtusely rounded at the shoulder, rounding abruptly to the subsutural channel, and conoidally attenuated to a narrow slightly emarginate front; ribs thick, obtusely rounded (usually nineteen, rarely fifteen, and in one case twenty-four in the last whorl), usually becoming obsolete at about half the length of body-whorl (sometimes shorter and often somewhat longer), but becoming very prominent, and separated by rather wider, deep concave spaces, at the shoulder, where each terminates in an obtusely rounded end at the constriction or subsutural groove, above which each rib seems continued as a blunt conoidal tu-

bercle; a narrow, step-like, undulated, flattened or slightly concave space extends to the suture perpendicular to the axis; lower or anterior half of body-whorl strongly marked with transverse or obliquely spiral deep narrow sulci, having broader flattened spaces between them, occasionally extending more faintly a further variable distance towards the suture; mouth with a slight posterior channel, oblong, narrowed in front; outer lip smooth within (edge sometimes very faintly crenulated in old individuals); inner lip slightly curved, with four slender, oblique, nearly equal plaits about the middle, the anterior slightly longer than the posterior; occasionally traces of a very small fifth plait occur.

Usual length 1 inch 9 lines; body-whorl $\frac{72}{100}$ to $\frac{82}{100}$, penultimate whorl $\frac{13}{100}$ to $\frac{14}{100}$; width $\frac{43}{100}$ to $\frac{50}{100}$. Young, 5 lines long, body-whorl $\frac{75}{100}$, penultimate whorl $\frac{14}{100}$; width $\frac{50}{100}$: at this size only three sculptured whorls at the pullus, twenty-two ribs on body-whorl. Some species show that the mouth was dark violet within.

From the examination of a great number of specimens from the Lower Miocene or "Tongrien" beds of Lattorq, near Bemberg, I long ago satisfied myself that the *V. suturalis* and *V. cingulata* of Nyst were only extreme varieties of one species; and Beyrich seems somewhat inclined to the same opinion, from examination of a larger number of specimens from other localities, of one of the varieties at least, than Nyst seems to have had of either, as he marks them both as rare in his 'Coquilles et Polypiers Fossiles de Belgique;' and the latter name would be the best to retain, as it indicates the remarkable girdling of the whorls by the deep sulcus or constriction which seems to cut off a subsutural row of tubercles from the ends of the longitudinal ribs in the most common variety; still, as in the *V. bulbula*, Lam., to which Nyst likens the *V. suturalis*, specimens may be found showing all the transitions between the most strongly marked subsutural sulcus and its entire absence. The latter variety I mark *β. indivisa*; and in it the ribs are often fewer and more sigmoid, and the shell narrower, than in the ordinary forms, though none of these characters are constant; in this variety, too, the spiral striæ are often confined to the anterior base of the shell, leaving the body intact and the ribs smooth and polished. Var. *α. perstriata* has the ribs rather more numerous and straighter than in the ordinary type, and the spiral striæ very strongly marked over the whole body-whorl and spire, so as to be in this respect intermediate between the Hampshire Barton Clay *V. ambigua* and *V. digitalina*. In this variety the teeth sometimes reach six or seven; the obtuse swollen papillary "pullus" to the top of the spire readily separates it on compa-

rison of specimens; and the sutural space of the Australian species is never so deep or concave as in its European prototype, in which also the plaits on the columella are very much less conspicuous and more oblique, the anterior one alone approaching the size of the four on *V. anticingulatum.* The spire has one sculptured whorl, fuller than in the *V. cingulata* of Germany. There is no living species like it.

Very abundant, with occasionally the β variety and more rarely the α variety, *perstriata,* in the Tertiary sands of the Bird Rock beds, Ad. 22 to 21, less so in Ad. 23. Both varieties common in the sandy beds Ad. 24.

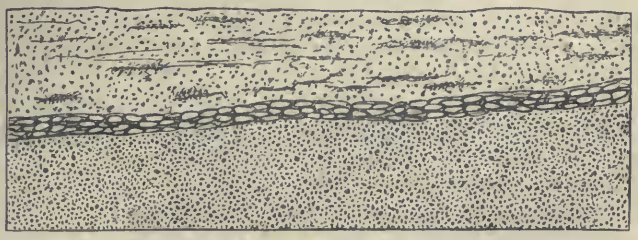
XLVIII.—*On a Phosphatic Deposit in the Lower Greensand of Bedfordshire.* By J. F. Walker, F.C.S., Sid. Suss. College, Cambridge*.

[Plate XIII.]

The Lower Greensand formation in Bedfordshire consists of extensive beds of variously coloured sands, more or less indurated into stone.

In the vicinity of Sandy there exists a conglomerate which it is proposed to discuss in this paper. A short account of this bed, by the Rev. P. B. Brodie, appeared in the 'Geological Magazine' for April. I sent a short paper on the discovery of some fossils in it to the 'Annals and Magazine of Natural History' for July; Mr. H. Sceley this month (August) also communicated his views on this bed in a letter to the Editors of that Magazine.

This conglomerate was formerly quarried for mending the roads, until two or three years since, when it was discovered that it contained nodules of phosphatic matter, for which it is at present extensively worked. At a cutting near the Potton Railway station the bed is from 9 inches to 1 foot in thickness; and the following is the section, the strata here being slightly inclined.



1. Sand of different colours, in some places white.
2. Conglomerate bed, 9 inches to 1 foot in thickness.
3. Sand of various colours, containing layers of oxide of iron, 12 feet.

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* Communicated by the Author, having been read before the British Association, in Sections B. and C., at Nottingham, 1866.